

HABITAT QUALITY AND ANADROMOUS FISH PRODUCTION POTENTIAL
ON THE WARM SPRINGS INDIAN RESERVATION

Annual Report
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prepared by
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ABSTRACT

In 1989, Project 81-108: Habitat Quality and Anadromous Fish Production Potential in the Confederated Tribes of Warm Springs Indian Reservation was in the eighth year of a scheduled eleven year program. To date, 26 kilometers of Reservation stream habitat have been enhanced for salmonid production benefits.

study sites, located in the Warm Springs River Basin and Shitike Creek, continued to be monitored for physical and biological parameters. Post treatment evaluation of bioengineering work was conducted in Mill Creek for the Strawberry Falls Project, and the Potter's Pond Project. Post treatment evaluation continued in Beaver Creek for the Beaver Creek Dahl Pine Project and Lower Beaver Creek Juniper Rip-Rapping Project. Pretreatment and post treatment evaluation of bioengineering work was conducted in Lower Shitike Creek for the Habitat Improvement Project that was completed in 1989. Although few changes in biological and physical habitat parameters from 1989 were observed, spring chinook salmon (Oncorhynchus tshawytscha) and summer steelheadtrout (Oncorhynchus mykiss) distribution and utilization of project site habitat was expanded.

A minor maintenance project was conducted at the Lower Beaver Creek Juniper Rip-Rapping Project. Projects objectives included repair and stabilization of bioengineering structures.

Two fencing projects, the Beaver Creek (Dahl Pine) Project and the Mill Creek (Potter's Pond) Project, were completed. Riparian vegetation enhancement and protection of previously built bioengineering structures are project objectives.

The Lower Shitike Creek Habitat Improvement Project (Phase I) was completed. A total of 813 bioengineering structures were placed along 2.9 kilometers of creek to improve salmonid spawning, rearing and passage. Problematic hydrologic and geomorphologic areas within the project site and time restraints prevented the project from being finished in FY 1988. An additional 360 meters of creek was enhanced by the completion of this complex bioengineering work in 1989 (Phase II).

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INTRODUCTION

The Confederated Tribes of the Warm Springs Indian Reservation of Oregon, in conjunction with funding and technical assistance from the Bonneville Power Administration, have continued to survey and improve the anadromous fisheries resources on the Reservation.

Implementation and evaluation of habitat enhancement projects described as Phase III (Fritsch 1986) of the Program included the Lower Shitike Creek Habitat Improvement Project, the Beaver Creek (Dahl Pine), and the Mill Creek (Potter's Pond) Fencing Projects.

Post treatment physical and biological habitat evaluation (Fritsch 1986) continued for the Strawberry Falls Passage Project, the Lower Beaver Creek Juniper Rip-Rapping Project, the Beaver Creek (Dahl Pine) Enhancement Project, and the Mill Creek (Potter's Pond) Enhancement Project.

STUDY AREA

The location, physical geography, associated hydrology and past history of the Warm Springs River Basin and Shitike Creek have been previously described in detail by Fritsch (1986) and CH2M Hill (1982).

In 1989, major completed enhancements project included the Lower Shitike Habitat Improvement Project, the Beaver Creek (Dahl Pine) project previously described in detail by Heinith (1988). Field sampling was conducted in Shitike Creek, the Warm Springs River, and its tributaries, Beaver and Mill Creeks. Monitoring site designations were consistent with those described in Fritsch (1986).

Four monitoring sites were located in Beaver Creek (Fritsch 1986). These included Lower Island, Reach A, Reach B Test, and Reach B Control. Each site was surveyed and documented for juvenile salanid abundance, biomass, shifts in rearing distribution and physical habitat parameters. Reach A and B were considered post treatment areas after the completion of the Beaver Creek (Dahl Pine) Enhancement Project and Fencing Project. Lower Island was considered a post treatment area after the completion of the Lower Beaver Creek Juniper Rip-Rapping Project.

Mill Creek post treatment monitoring sites included above and below Strawberry Falls and the Potter's Pond site (Fritsch 1986). All sites except for Potter's Pond were primarily for evaluation of the

Strawberry Falls Passage Project, implemented and completed in FY 1984. The Potter's Pond site was located within the boundaries of the Potter's Pond Project, implemented and completed in FY 1987 (Heinith 1987). All Mill Creek sites were monitored for juvenile salmonid abundance, biomass, shifts in rearing distribution and physical habitat parameters.

Two Shitike Creek monitoring sites included the previously surveyed Headworks and Upper Crossing sites were evaluated (Fritsch 1986). These continued to be assessed for juvenile salmonid abundance, biomass, shifts in rearing distribution and physical habitat parameters. Four other Shitike Creek monitoring sites were located within the Lower Shitike Habitat Improvement Project (Heinith 1988). These were surveyed for physical habitat parameters only.

METHODS AND MATERIALS

Using techniques and procedures described by Fritsch (1986), fish abundance, biomass, shifts in rearing distribution and selected physical parameters were measured for the previously described study sites. Major instream enhancement work was completed in Lower Shitike Creek. Riparian enhancement fencing was completed at Beaver Creek (Dahl Pine) and Will Creek (Potter's Pond). The biological and physical habitat sampling was restricted to a one month period from 3 August 1989 to 30 August 1989 to keep within the consistent sampling timeline (Heinith 1987). Pretreatment and post treatment project data was collected from sites on Lower Shitike Creek. First year post treatment data were acquired from the Lower Beaver Creek (Island Area) Project. Second year post treatment data were acquired from the bioengineering work in Mill Creek (Potter's Pond). Third year post treatment data were collected from the bioengineering work in Beaver Creek (Reach A and Reach B). Forth year post treatment data were gathered above and below Strawberry Falls on Mill Creek. Redd counts, temperature and discharge baseline data continued to be obtained from the Warm Springs River. Photopoints were taken within all pretreatment and post treatment project boundaries for visual evaluation of project areas.

Fish Abundance and Biomass

Salmonid populations were measured at ten monitoring sites following electroshocking techniques and procedures described in Fritsch (1986). Evaluations of adult salmonid passage and upstream

utilization were determined by spawning ground surveys (Fritsch 1986) and applied to the Strawberry Falls Passage Project, the Beaver Creek (Dahl Pine) Project, the Lower Beaver Creek Juniper Rip-Rapping Project and the Lower Shitike Creek Project.

Physical Habitat Parameters

Physical stream parameters including surface area, water volume, discharge, and temperature were recorded at select monitoring sites. Similarly, cover, substrate, pool-riffle ratio, depth and width data were collected, using techniques described in Fritsch (1986). Site mean monthly averages for water temperature and discharge were recorded. Post treatment stream habitat data were obtained on Beaver Creek and Mill Creek. Pretreatment data were collected at the four Lower Shitike Creek sites within the 1989 Lower Shitike Creek Habitat Improvement Project.

Photopoints

Photopoints continued to be taken for visual evaluation of pretreatment and post treatment project sites. Sites included Beaver Creek (Dahl Pine), Mill Creek (Potter's Pond), Lower Shitike Creek and Lower Beaver Creek (Island Area) (Heinith 1988). Photopoints will be utilized as a primary tool for project evaluations in the future.

Lower Beaver Creek Juniper Rip-Rapping Maintenance Project

On 3 July 1989, a maintenance project on the N 1988 Lower Beaver Creek Juniper Rip-Rapping Project (Heinith 1988) was implemented to assure overall project benefits. Approximately 15 boulders and 8 juniper trees were fabricated and placed using techniques described in Heinith (1988).

Lower Shitike Creek Habitat Improvement Project

The project objective was to improve 3.2 km of riparian and instream anadromous salmonid habitat, thereby assisting adult passage to upstream areas and to increase the creek's spawning and rearing potential. Phase I of the project took place between Rkm 1.4 and Rkm 4.6 from July 10, 1988 to August 10, 1988 (Heinith 1988).

Phase II of the project also took place between Rkm 1.4 and Rkm 4.6, but was not implemented until 15 July 1989 and was completed on 7 August 1989. Project planning and construction proceeded in the same fashion and detail as Phase I of the project (Heinith 1988).

A total of 1,200 boulders approximately 1 cubic meter in size were utilized during Phase II to construct fire boulder bems and secure 68 juniper trees (Table 1). Additionally, 3850 cubic meters of gravel bars and stream banks were excavated and sloped. Post construction work included placement of 230 cubic meters of pit run material and 122 cubic meters of top soil to feather a new bankline to the old high bank to protect project structures. Boulder

Table 1. Summary of structure types and numbers used in the FY 1989 Lower Shitike Creek Project (Phase II).

<u>Structure Type</u>	<u>Number</u>
Rock berms	5
Juniper Rip-rap	68
Rock Clusters and turning rocks	<u>85</u>
Total	158

bioengineering structures were design and juniper trees were fabricated and place using techniques describe in previously implemented projects (Fritsch 1986, Heinith 1987, 1988).

Beaver Creek (Dahl Pine) Fencing Project

This project along with the Mill Creek (Potter's Pond) Fencing Project was contracted to the lowest bidder in August 1988 (Heinith 1988). The original contractor defaulted on the contract and another contractor was chosen after another round of bid. Work finally began in October, 1988 and was completed on April 27, 1989.

Mill Creek (Potter's Pond) Fencing Project

This project along with the Beaver Creek (Dahl Pine) Project, was contracted to the lowest bidder in August, 1988 (Heinith 1988). The lowest bidder defaulted on the contract and another contractor was chosen after a second round of bids was conducted in October, 1988. Because the Beaver Creek (Dahl Pine) Fencing Project was completed first, construction for the Potter's Pond Fencing Project was delayed until January, 1989. The project was completed on April 27, 1989, and materials and structures were similar to those utilized for the Beaver Creek (Dahl Pine) Fencing Project (Heinith 1988). Table 2 summaries the structure type and number used in project construction. As with the Beaver Creek Fencing Project, the Potter's Pond Fencing enclosure was planned in cooperation with local tribal grazing groups, Tribal Range Committee and Tribal Council. The project will be monitored using photopoints, and physical habitat surveys.

Table 2. Summary of structure types and numbers used in the FY 1989 Hill Creek (Potter's Pond) Fencing Project.

<u>Structure Type</u>	<u>Number</u>
Rock Cribs	18
Single H - brace	5
Double H - brace	2
Gates	<u>3</u>
Total	28

RESULTS

Juvenile salmonid sampling data is summarized in Table 3. Summer steelhead spawning ground counts for all index areas are indicated in Table 4. Spring chinook spawning ground counts are exhibited in Table 5. A yearly comparison of spring chinook redd counts in historical index areas is provided in Table 6. Anadromous salmonid spawning ground counts within habitat enhancement sites are displayed in Table 7.

Physical habitat parameters were measured in all post treatment sites. Pretreatment data was collected only at the four sites within the 1988 Lower Shitike Creek Habitat Improvement Project. General parameters such as pool and riffle areas are displayed in Table 8 and 9. Riffle substrate composition by rank percentage is exhibited in Table 10. Site mean cover data is compiled in Table 11.

TABLE 3. Estimated abundance and biomass of salmonids in sample sites in the Warm Springs Basin and Shitike Creek, 1989.

Stream	Site (km)	Surface Area (m ²)	Chinook Salmom					Rainbow Trout					Brook Trout					Bull Trout					Total Salmonids				
			No.	95% CL (%)	Fish /m ²	Biomass	Gm/m ²	No.	95% CL (%)	Fish /m ²	Biomass	Gm/m ²	No.	95% CL (%)	Fish /m ²	Biomass	Gm/m ²	No.	95% CL (%)	Fish /m ²	Biomass	Gm/m ²	No.	95% CL (%)	Fish /m ²	Biomass	Gm/m ²
Beaver Cr.	Lower Island (1.6)	785.9	16	10	.020	107.0	.136	148	28	.188	1006.7	1.281	-	-	-	-	-	-	-	-	-	-	164	38	.209	1113.7	1.417
	Reach A Test (24.1)	373.9	80	5	.214	280.8	.751	40	179	.107	392.8	1.051	-	-	-	-	-	-	-	-	-	-	120	184	.321	673.6	1.802
	Reach B Test (29.0)	400.5	93	3	.232	459.4	1.147	60	10	.150	616.8	1.540	-	-	-	-	-	-	-	-	-	-	153	13	.382	1076.2	2.687
	Reach B Control (29.8)	303.1	40	3	.132	189.6	.626	83	12	.274	258.1	.852	-	-	-	-	-	-	-	-	-	-	123	15	.406	447.7	1.478
Mill Cr.	Potters Pond (8.8)	818.7	8	120	.010	36.0	.044	199	12	.243	1064.7	1.300	-	-	-	-	-	-	-	-	-	-	207	132	.253	1100.7	1.344
	Below Strw. Falls (11.3)	645.3	23	26	.036	123.3	.191	69	12	.107	272.6	.422	-	-	-	-	-	-	-	-	-	-	92	38	.143	395.9	.613
	Above Strw. Falls (14.2)	999.6	81	7	.081	315.1	.315	151	8	.151	400.2	.400	3	0	.003	130.5	.131	-	-	-	-	-	232	15	.235	845.8	.846
Shitike Cr.	Head Works (8.0)	759.4	4	0	.005	30.5	.040	248	9	.327	674.6	.888	-	-	-	-	-	-	-	-	-	-	252	9	.332	705.1	.928
	Upper Xing (16.1)	837.4	25	7	.030	165.0	.197	198	6	.237	663.3	.792	-	-	-	-	-	*	*	*	*	*	223	13	.267	828.3	.989

*Unable to make estimate (Two spawning adults captured in Pass #1)

Table 4. Summer Steelhead redd counts by index area in the Warm Springs River basin and Shitike Creek, 1982-1989.

Index Area	YEAR							
	1982	1983	1984	1985	1986	1987	1988	1989
Warm Springs River System:								
Beaver Creek						6	0	0
Reach D (top) to Robinson Park	-	-	-	-	-	31	14	9*
Robinson Park to Dahl Pine	2	-	-	-	1	12	11	7
Dahl Pine to Canyon	3	-	-	-	3	5	1	0
Old Bridge to Powerline	1	-	-	-	-	12	7	3@
Island Area	0	-	-	-	-	-	-	-
Mill Creek								
B-241 road bridge area	-	-	-	2	0	2	0	0
Old Mill to Strawberry Falls	-	-	-	0	4	7	10	1
Strawberry Falls to Potters Pond	3	-	-	-	3	2	12	2#
Potters Pond to Boulder Confl.	10	-	-	-	2	5	8	2
Warm Springs River								
Bunchgrass to Schoolie	13	-	-	-	-	-	-	-
Schoolie to He-He	6	-	-	-	-	-	-	-
He-He to McKinley Arthur Place	0	-	-	-	-	-	-	-
WSNFH to Culpus Bridge	<u>5</u>	-	-	-	-	-	-	-
TOTALS FOR W.S.R. System	43	-	-	2	13	82	63	24
Shitike Creek								
Peter's Pasture Area	-	-	-	-	0	2	2	1
Upper Xing to Bennett Place	12	2	4	19	6	7	9	4
Bennett Place to Headworks	1	4	13	7	2	3	9	3
Headworks to USGS Station	22	-	-	-	3	9	7	0
(Thompson Bridge)	-	8	13	17	-	-	-	-
USGS to Community Center	21	-	-	-	31	5	13	0
Community Center to Mouth	<u>8</u>	<u>1</u>	<u>9</u>	<u>10</u>	-	<u>28</u>	<u>12</u>	<u>4</u>
TOTAL	64	15	39	53	42	54	52	12

* Two redds were located within the FY 86 Beaver Creek (Dahl Pine) Habitat Enhancement Project.

@ One redd was located within the FY 88 Lower Beaver Creek Juniper Rip-rapping Project.

Two redds were located within the FY 87 Mill Creek (Potter's Pond) Habitat Enhancement Project.

TABLE 5. SPRING CHINOOK REDD COUNTS BY REACH
WARM SPRINGS RIVER BASIN AND SHITIKE CREEK 1982-1989

INDEX AREA (KM)	YEAR							
	1982	1983	1984	1985	1986	1987	1988	1989
WARM SPRINGS RIVER BASIN								
BEAVER CREEK:								
Reach D (to)								
to Robinson Park [a] (2.4)	-	-	-	-	1	0	4	0
Robinson Park to Dahl								
Pine (7.0)	15	59	91	42	38	46	38	36
Dahl Pine to Canyon (2.7)	23	24	7	17	13	27	24	46
Old Bridge to Powerline (1.4)	26	12	12	14	8	11	11	13
Powerline to Island								
[a] (9.6)	-	-	18	13	26	14	5	3
Island Area (0.8)	8	9	18	8	7	3	1	2
MILL CREEK:								
B-241 road bridge area								
[a] [b] (2.7)	15	3	16	17	0	0	0	0
Old Mill to Strawberry								
Falls [a] (2.9)	-	-	0	1	7	2	3	0
Strawberry Falls to								
Potters Pond (4.2)	11	7	5	5	19	12	7	4
Potters Pond to Boulder								
Creek (3.0)	14	15	9	10	6	9	19	23
WARM SPRINGS RIVER:								
Bunchgrass to Schoolie (6.4)	140	112	93	123	120	143	106	80
Schoolie to He-He (10.6)	133	135	97	90	129	142	119	119
He-He to McKinley Arthur								
Place (3.0)	36	40	21	23	43	40	41	60
McKinley Arthur to								
Badger Creek [a] (2.9)	-	17	28	14	0	29	18	21
WSNFH to Culpus Bridge (3.0)	12	5	14	21	11	6	5	8
TOTAL FOR WARM SPRINGS BASIN:	<u>433</u>	<u>438</u>	<u>429</u>	<u>398</u>	<u>428</u>	<u>484</u>	<u>401</u>	<u>415</u>
Adults arriving at WSNFH	2303	1878	1981	2172	1808	2181	2009	3744
Jacks arriving at WSNFH	67	34	301	62	240	306	394	191
TOTAL:	<u>2370</u>	<u>1912</u>	<u>2282</u>	<u>2234</u>	<u>2048</u>	<u>2487</u>	<u>2403</u>	<u>3935</u>
Adults sent upstream	1587	1251	1322	1264	1211	1550	1259	1254
Jacks sent upstream	46	34	164	56	55	86	69	65
TOTAL:	<u>1633</u>	<u>1285</u>	<u>1486</u>	<u>1320</u>	<u>1266</u>	<u>1636</u>	<u>1328</u>	<u>1319</u>
Redds in area above WSNFH	421	433	415	377	417	478	396	407
Total fish per redd	3.9	3.0	3.6	3.5	3.0	3.4	3.4	3.2
Adult fish per redd	3.8	2.9	3.2	3.4	2.9	3.2	3.2	3.1
SHITIKE CREEK:								
Peters Pasture [a] [c] (1.1)	-	-	-	-	-	0	0	0
Powerline to Upper Xing [a] (3.2)	-	-	-	-	-	-	-	3
to Bennett Place (4.5)	-	2	10	3	4	0	11	5
Bennett Place to								
Headworks [a] (2.7)	-	4	6	4	2	1	4	5
Headworks to USGS								
Station (Thompson Brdg) (3.0)	9	6	2	10	6	0	10	3
USGS Station to Comm. Ctr (3.2)	7	2	0	3	3	6	2	1
Community Ctr. to Mouth (3.2)	0	1	3	2	2	6	1	0
TOTAL:	<u>16</u>	<u>15</u>	<u>23</u>	<u>24</u>	<u>20</u>	<u>13</u>	<u>28</u>	<u>17</u>
[a] Historically a non index area								
[b] Adult chinook released at B-241 bridge (1982 - 1985)								
1982 - 47 adult spring chinook: 23 females, 24 males; 9 wild, 38 hatchery								
1983 - 10 adult spring chinook: 3 females, 7 males; all wild								
1984 - 40 adult spring chinook: 20 females, 20 males; 24 wild, 16 hatchery								
1985 - 42 adult spring chinook: 21 females, 21 males; 26 wild, 16 hatchery								

Table 6. Spring chinook redd counts in historical index areas in the Warm Springs River basin, 1969-1989.

YEAR	WARM SPRINGS RIVER		BEAVER CREEK	MILL CREEK	TOTAL	TOTAL ABOVE WSNFH
	Below WSNFH	Above WSNFH				
1969	No survey	205	39	20	-	264
1970	No survey	119	41	12	-	172
1971	No survey	152	15	6	-	173
1972	No survey	75	12	0	-	87
1973	No survey	396	154	34	-	584
1974	No survey	172	31	13	-	216
1975	No survey	560	162	86	-	808
1976	No survey	834	161	71	-	1066
1977	201	390	73	35	699	498
1978	8	620	119	49	796	788
1979	2	253	97	7	359	357
1980	3	86	22	6	117	114
1981	10	131	9	7	157	147
1982	12	309	72	40(25) ^{a/}	433(418)	421
1983	5	304(287)	104	25(22) ^{b/}	438(418)	433(413)
1984	14	239(211)	146(128)	30(14) ^{c/e/}	429(367)	415(353)
1985	21	250(236)	94(81)	33(15) ^{d/}	398(353)	377(332)
1986	11	292	66	25	394	383
1987	6	325	87	21	439	433
1988	5	266	74	26	371	366
1989	8	259	97	27	391	383

() Adjusted redd counts to account for historical index redd counts

Adult chinook released at B-241 Bridge (a thru d), (Non-Historical index area)

- a/ 47 adult spring chinook: 23 females, 24 males; 9 wild, 38 hatchery
b/ 10 adult spring chinook: 3 females, 7 males; all wild
c/ 40 adult spring chinook: 20 females, 20 males, 24 wild, 16 hatchery
d/ 42 adult spring chinook: 21 females, 21 males, 26 wild, 16 hatchery
e/ Strawberry Falls passage

TABLE 7. 1986-1989 Anadromous Salmonid Spawning Ground Counts within specific habitat enhancement project sites.

Enhancement Project Site	Redds Observed							
	1986		1987		1988		1989	
	summer steelhead trout	spring chinook salmon	summer steelhead trout	spring chinook salmon	summer steelhead trout	spring chinook salmon	summer steelhead trout	spring chinook salmon
Beaver Creek (Dahl Pine)	2	0	-	4	4	5	2	8
Mill Creek (Potters Pond)	-	2	-	4	1	2	2	0
Beaver Creek Juniper Rip-Rapping	-	7	12	3	7	1	1	2

TABLE 8. Habitat summary of sample sites in the Warm Springs River basin and Shitike Creek, 1989

Stream	Site	Rkm	Site Length(m)	Area (m ²)				a/ Total	Mean Depth(m)	Mean Width(m)	Volume (m ³)
				P	R	BW	SC				
Beaver Creek	Lower-Island	1.6	46.4	284	502	-	-	786	.20	16.39	155.1
	Reach A-Test	24.1	48.3	362	11	-	-	374	.21	7.74	79.4
	Reach B-Test	29.0	49.5	138	262	-	-	401	.14	8.06	56.9
	Reach B-Control	29.8	48.3	149	154	-	-	303	.15	6.38	44.3
Mill Creek	Potters Pond	8.8	89.6	394	425	-	-	819	.22	9.78	179.4
	Below Str. Falls	11.3	65.7	232	402	11	-	645	.28	9.80	180.5
	Above Str. Falls	14.2	116.4	297	703	-	-	1000	.25	8.80	247.3
Shitike Creek	Headworks	8.0	50	274	485	-	-	759	.24	15.57	184.7
	Upper Xing	16.1	57.6	353	485	-	-	837	.29	14.20	243.3
	#1	4.6	87.3	786	355	-	-	1141	.32	13.28	372.3
	#2	3.8	79.3	395	587	-	-	982	.25	12.39	247.1
	#3	2.4	97.3	333	782	-	134	1249	.27	12.93	332.5
	#4	1.6	92.0	325	694	9	132	1160	.33	12.57	381.6

a/ P-pool; R-riffle; BW-backwater; SC-side channel

TABLE 9. Summary of 0.15m area, usable pool area and undercut banks in sample sites in the Warm Springs River basin and Shitike Creek, 1989

Stream	Site	Rkm	Surface Area(m ²)	Area(m ²)					Volume(m ³)	
				<0.15m(%)	>0.15m(%)	Pool >0.15m(%)	Pool >1.0m(%)	Usable Pool 1.0m>P<0.15m(%)	Site	Undercut Bank(%)
Beaver Creek	Island	1.6	785.9	254.9(32.4)	531.0(67.6)	172.3(21.9)	0.0(0.0)	172.3(21.9)	155.1	0.87(0.6)
	Reach A	24.1	373.9	44.8(12.0)	329.1(88.0)	274.4(73.4)	0.0(0.0)	274.4(73.4)	79.4	0.04(0.05)
	Reach B-Test	29.0	400.5	141.8(35.4)	258.7(64.6)	43.4(10.8)	0.0(0.0)	43.4(10.8)	56.9	0.06(0.1)
	Reach B Control	29.8	303.1	100.4(33.1)	202.7(66.9)	68.1(22.5)	0.0(0.0)	68.1(22.5)	44.3	0.05(0.1)
Mill Creek	Above Str. Falls	14.2	999.6	238.6(23.9)	761.0(76.1)	199.3(19.9)	0.0(0.0)	199.3(19.9)	247.3	0.51(0.2)
	Below Str. Falls	11.3	645.3	111.5(17.3)	533.8(82.7)	177.1(27.4)	0.0(0.0)	177.1(27.4)	180.5	0.94(0.5)
	Potters Pond	8.8	818.7	231.8(28.3)	586.9(71.7)	194.3(23.7)	0.0(0.0)	194.3(23.7)	179.4	0.06(0.03)
Shitike Creek	Headworks	8.0	759.4	93.8(12.3)	665.6(87.7)	211.9(27.9)	0.0(0.0)	211.9(27.9)	184.7	0.24(0.1)
	Upper Xing	16.1	837.4	130.3(15.6)	707.0(84.4)	243.4(29.1)	0.0(0.0)	243.4(29.1)	243.3	0.12(0.1)
	#1	4.6	1141.2	231.5(20.3)	909.6(79.7)	553.8(48.5)	0.0(0.0)	553.8(48.5)	372.3	0.79(0.2)
	#2	3.8	982.1	310.8(31.7)	671.3(68.4)	204.2(20.8)	0.0(0.0)	204.2(20.8)	247.1	0.07(0.03)
	#3	2.4	1248.9	53.7(4.3)	1195.1(95.7)	225.7(18.1)	0.0(0.0)	225.7(18.1)	332.4	2.46(0.7)
	#4	1.6	1159.5	341.6(29.5)	817.9(70.5)	238.1(20.5)	0.0(0.0)	238.1(20.5)	381.6	0.48(0.1)

TABLE 10. Composition of riffle substrate in sample sites in the
Warm Springs River basin and Shitike Creek, 1989

Stream	Site	Rkm	Mean substrate rank a/	Substrate composition by rank (%) a/							
				1	2	3	4	5	6	7	8
Beaver Creek	Lower-Island	1.6	3.8	-	4.0	38.7	37.3	16.0	4.0	-	-
	Reach A-Test	24.1	5.1	2.7	2.7	5.3	16.0	22.6	44.0	76.7	-
	Reach B-Test	29.0	6.0		1.3	4.0	9.3	12.0	29.4	44.0	
Mill Creek	Potters Pond	8.8	6.3	-	-	4.0	6.7	9.3	24.0	42.7	13.3
Shitike Creek	#1	4.6	5.5	-	10.7	-	8.0	22.7	30.6	20.0	8.0
	#2	3.8	6.0	-	-	-	4.0	25.3	38.7	29.3	2.7
	#3	2.4	5.7	-	-	1.3	17.3	26.7	28.0	20.0	6.7
	#4	1.6	6.1	-	-	1.3	9.3	18.7	26.7	40.0	4.0

a/ Substrate ranks:

- | | |
|---------------------------|------------------------------|
| 1 - organic cover | 5 - 25-50mm (large gravel) |
| 2 - 2mm (sand) | 6 - 50-100mm (small cobble) |
| 3 - 2-5mm (pea gravel) | 7 - 100-250mm (large cobble) |
| 4 - 5-25mm (small gravel) | 8 - 250mm (boulder) |

TABLE 11. Summary of fish cover measurements in sample sites
in the Warm Springs River basin and Shitike Creek, 1989

Stream	Site	Rkm	Site Mean Cover %	Cover type (%) a/					
				1	2	3	4	5	6
Beaver Creek	Lower-Island	1.6	3.31	11.2	2.9	18.8	42.8	16.6	7.7
	Reach A-Test	24.1	9.38	39.4	-	40.9	5.0	13.8	0.9
	Reach B-Test	29.0	10.47	2.6	6.1	76.2	4.6	10.0	0.5
	Reach B-Control	29.8	6.08	3.1	8.2	80.8	-	3.0	4.9
Mill Creek	Potters Pond	8.8	2.99	6.0	39.1	17.5	3.6	-	33.8
Shitike Creek	#1	4.6	1.94	8.6	60.8	13.9	1.9	5.0	9.8
	#2	3.8	1.62	21.0	10.5	9.7	-	35.8	23.0
	#3	2.4	4.02	31.3	1.8	54.2	-	4.1	8.6
	#4	1.6	1.97	5.2	1.9	55.4	-	17.3	20.2

a/ Cover Types

- 1 - Logs, boulders, debris below water surface
- 2 - Logs, boulders, debris above water surface
- 3 - Overhanging vegetation 0.3 above water surface
- 4 - Aquatic vegetation
- 5 - Undercut banks
- 6 - Depth with surface turbulence

DISCUSSION

As this is an annual report and not a conclusive summary of Program 81-108's effect on anadromous salmonids, interpretations of individual project success are limited. Upon the Program's conclusion in 1991, a complete program evaluation will be documented in the Final 81-108 Report.

The individual instream structures and fencing projects will require periodic maintenance to assure maximum program benefits. Continued long term project monitoring and subsequent evaluation will ascertain Program 81-108's success in terms of achieving full salmonid seeding potential and determining site specific contributions to the overall anadromous fishery production in Reservation waters.

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